UAM Disturbance Rejection in Conceptual Design, Phase I

Completed Technology Project (2018 - 2019)

Project Introduction

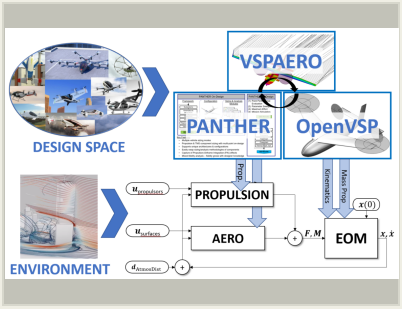
Complex and often violent urban wind environments pose a significant challenge to the safety and ride quality for vehicles intended for the Urban Air Mobility (UAM) market. UAM aircraft concepts must have control authority, turbulence rejection, and ride comfort as figures of merit at the forefront of the configuration selection process. However, the evaluation of handling qualities has traditionally been late in the design process when most of a vehicle's characteristics are established. Advanced design methods in early conceptual design are just recently adopting the use of physics-based aircraft dynamics models to identify handling quality metrics and educate the configuration down selection process. Attempts to extend those tools into unique VTOL configurations designed for the UAM market are not ubiquitous due to the increased complexity and diversity of VTOL concepts.

Empirical Systems Aerospace, Inc., (ESAero) will develop a quantitative ride quality assessment methodology and accompanying tool suite to enable the analysis and down-selection of eVTOL configurations during the conceptual design process. ESAero will leverage previous development of 6DoF dynamics simulations of vehicles with distributed electric propulsion (DEP) control authority to integrate handling qualities into the design and configuration process where system level changes are least expensive. Physics-based models in ESAero's Propulsion Airframe iNTegration for Hybrid Electric Research (PANTHER) tool suite will be extended to scalable dynamics models for the latest eVTOL propulsion technologies such as electric ducted fans (EDF) and small, distributed propellers. ESAero's recent expansion of OpenVSP/VSPAERO to characterize handling qualities will be utilized in the creation of the dynamics simulations. By leveraging OpenVSP, PANTHER, and physics based 6DoF simulation, this effort will enable rapid evaluation of handling qualities at the forefront of the conceptual design process.

Anticipated Benefits

The results of this effort will provide NASA with information on the UAM configuration and propulsion system integration challenges. Information from this study will be directly applicable to the NASA eVTOL reference models. Information from the use of this tool will also become invaluable as airspace traffic management strategies and technologies are developed such as UTM.

The results of this effort can be directly applied to many major commercial efforts such as those being actively pursued by UBER, Joby Aviation, and many others. External to NASA many public agencies can benefit from this analysis including the FAA, local, state, and public agencies. Urban planning agencies can also utilize these results to help reduce extreme wind conditions within city centers.



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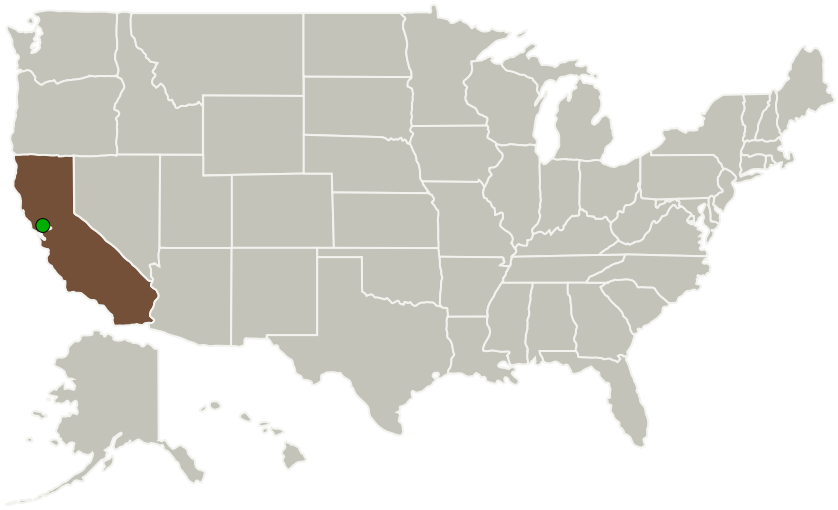
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Empirical Systems Aerospace, Inc.(ESAero)	Lead Organization	Industry	Pismo Beach, California
Ames Research Center(ARC)	Supporting Organization	NASA Center	Moffett Field, California

Primary U.S. Work Locations
California

Project Transitions

July 2018: Project Start

February 2019: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/138549)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Empirical Systems Aerospace, Inc. (ESAero)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Nicholas Brake

Co-Investigator:

Nick Brake

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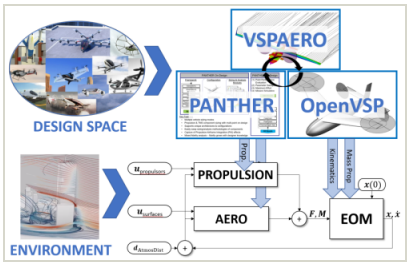
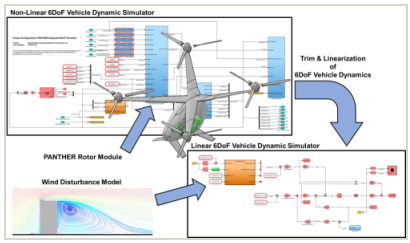
Images



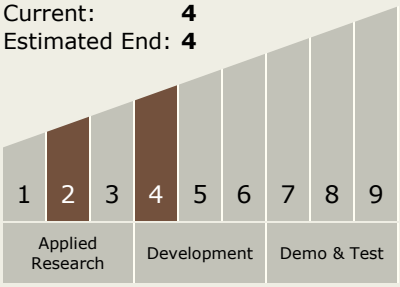
Briefing Chart Image
UAM Disturbance Rejection in Conceptual Design, Phase I
(https://techport.nasa.gov/image/128679)



Final Summary Chart Image
UAM Disturbance Rejection in Conceptual Design, Phase I
(https://techport.nasa.gov/image/134091)

Technology Maturity (TRL)

Start: **2**
Current: **4**
Estimated End: **4**



Technology Areas

Primary:

- TX15 Flight Vehicle Systems
  - TX15.1 Aerosciences
    - TX15.1.8 Ground and Flight Test Technologies

Target Destination

Earth